CHARACEAE OF THE PUT-IN-BAY REGION OF LAKE ERIE (OHIO)[1]

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During the summer of 1940, while a student at the Franz Theodore Stone Laboratory of the Ohio State University, the writer made a series of collections of the Characeae from the Put-in-Bay region of Lake Erie. Further collections were made during brief visits in 1941, at which time the entire shore line of the bay was dredged with "Nordstedt hooks"[3] in an attempt to rediscover several species previously reported by Pieters (1901). The determinations of the collections were recorded in a Master's Degree Thesis at Northwestern University (Wood, 1942). In 1946, the writer was able to compare his material with the original Pieters collections and with additional specimens in the New York Botanical Garden, and to review his original determinations in light of what had been learned through personal association with G. O. Allen of England.

The objective of the present paper is to present as workable a treatment as practicable to enable students of the Biological Station to determine the Characeae of the region. To attain this objective, the classical arrangement for such a work has been somewhat forfeited in the following ways: (1) the key which attempts to contrast differences in apparently similar species regardless of taxonomic relationships; and (2) the illustrations which, having been prepared in chart form with structures of similar species placed together and reproduced at the same magnification, enable ease in comparing and contrasting critical characters with a plant in hand. The terminology has, as far as possible, been stated in non-technical words with the technical terms inserted parenthetically.

The nomenclature, for the convenience of the student, follows that of T. F. Allen's *Characeae of America*, Part II (1892, '94, '96) for the Nitellas, and Robinson's *The Chareae of North America* (1906) for the Charas. This has been done because these works are the most usually available studies of the American forms. Deviations from this nomenclature, as indicated in recent monographic works, are noted in the discussion of each species.

Although the objective has aimed at clarification and simplification for student use, every attempt has been made to bring the fundamental data in accord with the most recent trends in the taxonomic literature of the Characeae.

THE REGION

The Put-in-Bay region is delimited in this study to an area including South Bass, Middle Bass, North Bass, and their adjacent islands, Catawba Point, and inland to the Blue Hole of Castalia. For a discussion of the region, the reader is referred to Tiffany (1937, p. 912).

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[2]The writer wishes to acknowledge with deepest sincerity the inspiration and aid of C. E. Taft of the Ohio State University in suggesting this problem. The gracious cooperation of F. J. Seaver and Rosalie Weikert, of the New York Botanical Garden, who made the vast collections of that institution available for study, was invaluable. He is deeply indebted to G. O. Allen, well-known English authority on Charophyta, for the hospitality, patience, and instruction during the writer's visits in the war years. The author especially acknowledges the encouragement and guidance of his adviser, L. H. Tiffany, of Northwestern University.

[3]Allen, T. F. Bot. Gaz. 12: 297, 1887.

COLLECTIONS AND LITERATURE

Apparently the only work on the Characeae of this region was published by Pieters (1901) in his *Plants of Western Lake Erie*, based on his collections in the area in 1898. The material was determined by T. F. Allen and Otto Nordstedt. In this study were reported 14 species, 1 variety, and 10 forms; and photographs of three species and two forms were included. Pieters' collection was deposited in the Cryptogamic Herbarium of the New York Botanical Garden (NY).[4] For over forty years no further publications on the Characeae of the region appeared.

The writer's collection of 1940 and 1941 was prepared in duplicate. A set was left at the Stone Laboratory, representative specimens of all species were deposited in the Cryptogamic Herbarium of the Chicago Natural History Museum (F), and the remaining specimens were retained in the writer's herbarium (RDW).

NOTES ON TERMINOLOGY

The terms stem, branches, leaves, rays, dactyls, leaflets, bracts, spines, stipulodes, and heads are employed because of their general usage in the taxonomic literature. They are in part useful in that they suggest similar structures in flowering plants. The *stem* refers to the primary vertical axis. *Branch* refers to the one or two vertical axes which arise in the center of a whorl of leaves. *Leaf* refers to one of the laterals in a whorl at a stem or branch node. *Ray* refers to one of the segments of a furcated leaf in Nitellas. *Dactyl* refers to one of the set of rays beyond the last furcation of a leaf in Nitellas. *Leaflet* refers to one-celled processes arising at the sterile modes of leaves. *Bract* refers to one-celled processes arising at the base of the sex organs. *Spine* refers to the one-celled processes arising along the stem from the cortical nodes in Charas. *Stipulode* refers to the one-celled processes forming one or two rings about the stem at the base of the leaves in Chara. *Head* refers to occasional dense semi-globular clusters of short leaves which occur on certain Nitellas and are characteristic of Tolypellas. In modern literature (Groves and Bullock-Webster, 1920, 1924; Zaneveld, 1940), the term branchlet replaces our usage of leaf, bract replaces leaflet, and bracteole replaces our term bract.

The sex organs have been long known in the literature as antheridia and oogonia. The name *antheridium* is applied to the spherical sex organ in which the spermatozoids originate. In the light of recent morphological concepts (Goebel, 1930), this term is a misnomer; the term antheridium is restricted in use to the individual spermatogenic cells of the capitular filaments within the spherical structure. Smith (1938, p. 131) employs the noncommittal and more descriptive term, globule. The name *oogonium* is applied to the female sex organ which is encased by spirally twisted enveloping cells and terminated by a coronula of five (*Chara*) or ten (*Nitella*, *Tolypella*) terminal cells at the abaxial end. Smith employs the equally noncommittal word, nucule, for this structure. Both globule and nucule have occurred in the literature from time to time; and as the antheridia and oogonia, as taxonomically employed, are in themselves misleading, Smith's usage is to be recommended. Numerous other authors have attempted to establish more morphologically consistent terms such as antheridiocarp and oogoniocarp, antheridium and sporangium, antheridium and sporocarp. However, to be consistent with the majority of the literature, the writer has retained *antheridium* and *oogonium* in the present work.

NOTES ON TECHNIQUE

A study of the Characeae will be greatly facilitated by good plant material in fertile condition. In our region the best collecting is done in June and July before silt deposition and epiphytes cover the specimens, and while most of the species are fertile. However, certain types of treatment will render most specimens determinable. Charas with heavy lime incrustation can be treated with dilute nitric or hydrochloric acid to remove the carbonate. If objectionable bubbles remain in the tissues, the plants can be boiled for a moment, or placed in water

[4]Abbreviations for herbaria as used in locality records for each species follow Lanjouw (1939), with the exception of the herbaria of R. B. Gordon (RBG) and the author (RDW).

and subjected to suction from an aspirator pump until cleared. Specimens covered with silt deposition or epiphytes can generally be cleaned by cautious wiping of critical structures to be studied.

For study collections, it is advisable to prepare both dry herbarium mounts for permanent record and preserve specimens in 4% formalin or some other algal preservative. For herbarium mounts, the plants are best floated out in a pan so as to assume a natural appearance. Mounting paper can then be slid under the specimen and the material cautiously lifted from the water so as not to disarrange the plant. The material can be covered with cloth, and dried between blotters. The cloth can then be carefully peeled off, leaving the plant attached to the paper. The writer routinely puts the wet specimens between folded newspaper instead of using cloths. Certain charas will not stick to the mounting paper, and in such cases a weak solution of mucilage can be used in place of water for floating out the specimens. If this latter method is employed, the use of cloths is almost required.

Microscopic study of the critical portions is generally essential, though with practice most local forms can be recognized at sight. Sex organs, though not obligatory in all cases, are essential in certain species such as *Chara Haitensis* and *C. compacta.*

In determining Charas the cortical cells along the stem are a major character to be studied. In order to determine the numerical relation between the corticating cells and the leaves in an adjacent leaf whorl, one may actually count the cells across a portion of the stem and the number of leaves in the whorl above or below, and decide whether the cortical cells are one, two, or three times the number of leaves in a whorl. In practice, however, one generally inspects the cortication and locates the primary cells by the presence of spines or nodal cells. Where these primary cells lie side by side, the number of cortical cells will be equal to that of the leaves in a whorl (*haplostichous*; no representatives in our flora, cf. *C. canescens* Lois.). Where a secondary cell lies between two such primary cells, the number of cortical cells will be twice that of the leaves (*diplostichous*, as in *C. contraria*, Plate III, fig. 3-A). Where two secondary cells lie between the primaries, the number of cortical cells will be three times that of the leaves in a whorl (*triplostichous*, as in *C. fragilis*, Plate III, fig. 4-A).

A second taxonomic character somewhat difficult to study is the presence or absence of cortication on the basal leaf internodal cell, especially since the stipulode ring at the base of the leaves may obscure these cells. However, under low power (100 *X*) one can separate the stipulodes and ascertain whether or not the cortication of the leaves extends completely to the base of the leaf (as in *C. fragilis*, Plate III, fig. 4-A), or whether it is interrupted by a clear portion—the naked base cell (*gymnopodous*, as in *C. Haitensis*, Plate IV, fig. 1-A, where two stipulodes are removed to show this cell). In practice one becomes accustomed to recognizing the apparently vacant space at the base of the leaves as indicating the gymnopodous condition rather than attempting to see the cells themselves. This appearance can often be recognized in the field.

The pattern of the oospore membrane is of diagnostic value especially in species of *Nitella*. This can easily be demonstrated by obtaining a *mature* oospore or oogonium, and crushing it gently under the cover glass on a slide in a drop of water. High dry objective (440 *X*) is generally adequate to make out the markings on the outer wall. In our species these patterns range from finely granular (*N. gracilis*, Plate I, fig. 2-E) to coarsely reticulate (*N. tenuissima*, Plate I, fig. 3-E).

KEY TO THE PUT-IN-BAY CHARACEAE

The following key should enable the student to determine all the local species in sterile or fertile conditions. The plates, which are arranged in nearly the same order as the key entries, can be conveniently used on questions of terms. In

essence, the plates form a pictorial key in themselves, and with little practice will replace rather than supplement the following presentation:

1. Stems smooth, not striated lengthwise (uncorticated).....(2)
1. Stems striated lengthwise (corticated).....(9)
   2. Leaves in whorls not forked or divided; spine-like stipulodes encircle the stem at the base of the leaves; antheridia occurring at the base of the oogonia.....(8)
   2. Leaves in whorls usually one or more times divided or forked; without a circle of spine-like stipulodes at the base of the leaves; antheridia, if at the same node as the oogonia, then above or beside it, not at the base of it.....(3)
3. Dense globular clusters of short, fertile leaves forming heads which are borne in center of whorls of elongated sterile leaves.....(4)
3. Without globular heads; leaves similar throughout.....(5)
   4. Heads 3–8 per plant, 2–3 (or more) cm. in diameter; tips of fertile leaves terminated by a series of short cells and a conically pointed tip....5.[5] *Tolypella intertexta*
   4. Heads 20 or more per plant, up to 8 mm. in diameter; tips of fertile leaves not terminated by a series of short cells, the long dactyls narrowing to a point, 1. *Nitella subglomerata*
5. Tips of leaves narrowing to a point, not terminated by a small apical cell (mucro); fertile leaves clustered in small globular heads about 8 mm. in diameter, 1. *Nitella subglomerata*
5. Tips of leaves terminated by 1 or more minute apical cells; fertile leaves not clustered into heads.....(6)
   6. The small apical cells of the leaves consisting of a single-celled mucronate tip (Plate I, fig. 2-A).....(7)
   6. At least some of the mucronate tips more than one-celled, varying from a single-celled mucro, to a mucro and a somewhat longer penultimate cell, to a 2–4–cuspidate crown (Plate I, fig. 4-A).....4. *Nitella megacarpa*
7. Main stem axis not continuous throughout the plant, but branching frequently at nodes resulting in a diffuse type of growth; number of cells in the ultimate divisions of the leaves (dactyls, Plate I, fig. 2-B) varying from 2–3, of which the terminal cell is a small mucronate tip, and the lower 1 or 2 are elongated leaf cells.....2. *Nitella gracilis*
7. Main stem axis generally continuous throughout the plant, rarely appearing branched or diffuse, the whorls of leaves being regularly distributed along the stem; number of cells in the ultimate divisions of the leaves (dactyls) uniformly 2, of which the terminal cell is a small mucronate tip, and the lower an elongated leaf cell, 3. *Nitella tenuissima*
   8. Spine cells (bracts) arising from the base of the oogonia shorter than the oogonia (about one-half length of the mature fruit); leaflets at the sterile leaf nodes reduced to mere papillae, less than 2 times as long as wide, usually obscure, 6. *Chara Braunii*
   8. Spine cells arising from the base of the oogonia as long or longer than the oogonia; leaflets at sterile leaf nodes well developed, generally more than 3 times as long as wide, forming a circle of spines about each node of the leaf...7. *Chara Schweinitzii*
9. Leaves corticated with the exception of 1 or more terminal cells; the basal leaf cell always corticated; stipulodes either obscure or up to 3 times as long as wide, and in 2 rows, an upper and a lower series.....(10)
9. Leaves either corticated or uncorticated, but in either case, the basal leaf cell is always uncorticated. If leaves corticated, the stipulodes more than 5 times as long as wide, and in two rows. If leaves uncorticated, the stipulodes long, but in only one row....(12)
   10. Number of cortications of stem 2 times the number of leaves in an adjacent leaf whorl (diplostichous); stipulodes generally less than 2–3 times as long as wide...(11)
   10. Number of cortications of stem 3 times the number of leaves in an adjacent leaf whorl (triplostichous); stipulodes obscure or merely papillae....10. *Chara fragilis*

[5]The numerals preceding the plant names correspond to their numbers in the text.

11. White bulbils generally present on rootlets; spine cells along the stem well developed on the upper internodes; stipulodes well developed, generally 2–4 times as long as wide; stem cortication irregular; antheridia and oogonia occurring on separate plants (dioecious) ..... 9. *Chara Macounii*

11. Without bulbils on rootlets; spine cells generally absent on stems, even on upper stem internodes, or if present, infrequent and very small; stipulodes rarely exceeding 2 times as long as wide, generally blunt; cortication regular; antheridia occurring at the base of oogonia at same leaf node (monoecious) ..... 8. *Chara contraria*[6]

12. Leaves uncorticated; stipulodes in one row; plants small, up to 10 or 15 cm. high ..... 11. *Chara Keukensis*

12. Leaves corticated, though the basal leaf internodal cell is always uncorticated; stipulodes in two well-developed rows, an upper and a lower series; plants up to 45 cm. or more high ..... (13)

13. Leaves straight, frequently exceeding 3 cm. in length; leaflets at sterile leaf nodes reduced to mere papillae; antheridia occurring at the base of oogonia[7], 12. *Chara Haitensis*

13. Leaves generally somewhat curved, rarely exceeding 2.5 cm. in length; leaflets at sterile leaf nodes forming a circle of spines about the node, regularly more than twice as long as wide; antheridia and oogonia occurring at different nodes of a leaf, or on different leaves of the same plant ..... 13. *Chara compacta*

Family **Characeae**

Subaquatic cryptograms with numerous chloroplasts per cell. Vegetative parts consisting of long internodal and short nodal cells, forming the stem and leaves. Leaves produced in whorls originating on the stem nodes. Sex organs borne on nodes of leaves. Sexual reproduction by means of biflagellate spiral-shaped antherozoids originating in the spherical male sex organ, and oospores borne in the female organ. Oogonium with envelope of five spirally arranged internodal cells, the apices of which form a coronula of small cells at the abaxial end of the oogonium. Germination gives rise to a protonema from which the plant sprouts as a lateral branch.

Tribe **Nitelleae**

Stems and leaves entirely without cortical cells. Branches similar to the main stem, two or more at a stem node, originating in the axils of the whorls of leaves. Leaves one or more times divided into one-celled rays, excepting the ultimate ray (dactyl) which may be more than one-celled. Cells of the coronula ten, in two superimposed series of five cells each.

Genus **Nitella**

Branches usually two at a stem node, opposite. Leaves one or more times furcate with more or less equal rays. Fertile leaves frequently contracted into heads. Antheridia terminal, in the furcations of the leaves, replacing the apical cell of a ray. Oogonia lateral at the leaf nodes, in monoecious species frequently just below the antheridia. Oospores laterally compressed.

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[6]Certain specimens collected by R. B. Gordon in 1946 have small spines which appear to arise from the furrows in dried specimens; or in which the secondary cortical cells are more prominent than the primaries. These fall within the definition of *Chara vulgaris* L. *pro parte* (cfr. *C. contraria*, in text).

[7]In deciding this character, if any antheridia occur with the oogonia, the plant is *C. Haitensis*. Frequently oogonia occur without the accompanying antheridia. In *C. compacta*, on the other hand, antheridia never occur at the same node as the oogonia. The presence of an isolated antheridium will strongly suggest *C. compacta*, but an isolated oogonium is not significant.

1. **Nitella subglomerata** Braun,[8] Monatsb. K. Akad. Wiss. Berlin, 1858, p. 356, 1858.

Allen, Char. of Amer. II, Fasc. I, p. 7, 1892. Daily, Butler Univ. Bot. Studies, 6: 151, 1944. Woods, Fl. Nebraska, p. 123, 1894.

N. acuminata var. *subglomerata* Braun, Abh. K. Akad. Wiss. Berlin, 1882, p. 36, 1883.

Allen, Bull. Torrey Bot. Club, 2(3): 9, 1871.

Plate I, Fig. 1

Plant monoecious, varying up to 15 or 20 cm. high; slender and fragile in habit. Leaves 6–8 in a whorl, 3–4 times furcate. Terminal rays of leaves narrowed to an acuminate point, one-celled. Fertile leaves contracted into somewhat globular heads about 8 mm. in diameter. Oogonia and antheridia aggregated. Oospores 260–270 μ long, showing about 6 striations; oospore membrane granular without rounded tubercles. Antheridia 270–360 μ in diameter.

In our flora this species is distinct in that it is the only *Nitella* which has terminal rays beyond the last division of the leaf consisting of only one large cell; i.e., not terminated by a mucronate tip.[9] *Tolypella intertexta* is somewhat similar in appearance since both it and *N. subglomerata* form globular heads. However, the number of such heads in *T. intertexta* is only one or two at a node, and these heads are well over 15 mm. in diameter. The heads of *N. subglomerata*, when present, are very abundant, up to 8 per nodal whorl, and each is about 8 mm. in diameter. Further, the fertile leaves of *T. intertexta* have terminal segments of several cells in contrast to the single-celled dactyls of *N. subglomerata*.

Illustrations: Allen, 1892, unnumbered plate; Woods, 1894, plate XXV.

Localities: Lake Erie—*A. J. Pieters a-25*, 1898 (NY); East Harbor—*A. J. Pieters a-55*, 1898 (NY).

2. **Nitella gracilis** (Smith) Agardh, Syst. Alg., p. 125, 1824.

Allen, Char. of Amer. II, Fasc. III, p. 23, 1896. Halsted, Proc. Bost. Soc. Nat. Hist. 20: 176, 1879. Braun, Abh. K. Akad. Wiss. Berlin, 1882, p. 58, 1883.

Chara gracilis Smith, Eng. Bot. pl. 2140, 1810.

Plate I, Fig. 2

Plant monoecious, varying up to 20 cm. high; stems very slender. Leaves 5–6 in a whorl, 2–3 times furcate; ultimate rays beyond the last division 2–3-celled, the apical cell being a very short mucronate tip, and the penultimate cell tapering toward the terminal tip. Oogonia and antheridia not aggregate, occurring at each furcation of the leaves. Oospore 250–300 μ long, showing about 6 rather prominent ridges. Oospore membrane finely granular. Antheridia about 300 μ in diameter.

The writer has been unable to verify this record, as the only specimen recorded for this locality was apparently on loan at the time of his visit to the New York Botanical Garden. Pieters (1901) listed this species as "*N. gracilis* Ag. *vel sp. affinis*," so that at best it remains a doubtful record.

Nitella gracilis differs from *N. tenuissima* in its diffuse habit, in its finely granular oospore wall, and by the cells of the dactyls which vary from 2–3 cells.

Illustrations: Allen, 1896, unnumbered plate; Groves and Bullock-Webster, 1920, pl. 13; Migula, 1925, p. 214, and 1897, p. 161.

Localities: Upper Sandusky Bay—*A. J. Pieters 64*, 1898 (NY). (Not seen by the writer.)

3. **Nitella tenuissima** (Desv.) Kützing, Phyc. Gener. p. 319, 1843.

Braun, Abh. K. Akad. Wiss. Berlin, 1882, p. 62, 1883. Halsted, Proc. Boston Soc. Nat. Hist. 20: 177, 1879. Allen, Char. of Amer. II, Fasc. II, p. 24, 1896.

Chara tenuissima Desvaux, Journ. de Bot. 2: 313, 1809.

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[8]Recent monographers, including Groves (1911, p. 32), Braun (1883, p. 36), Zaneveld (1940, p. 61), cite this species as *N. acuminata* var. *subglomerata* Braun.

[9]*Nitella flexilis* (Sm.) Ag., which should be anticipated in this vicinity, has acute or obtuse instead of acuminate dactyls.

Plate I, Fig. 3

Plant monoecious, varying up to 15 cm. high. Leaves 6–8 in a whorl, 3–4–times divided; ultimate rays beyond the last division invariably 2-celled, the apical cell being a very short mucronate tip, and the penultimate cell an elongated leaf cell not much broader than the base of the apical cell. Oogonia and antheridia at the second and third leaf node (not at first furcation). Oospores 200–250 μ long, showing 7–8 fine, low striations. Oospore membrane strongly reticulate, though at times beaded-reticulate. Antheridia about 175 μ in diameter.

Pieters (1901) reported this species as *N. batrachosperma* from East Harbor. The writer was able to see the specimen, and concurs with Nordstedt's determination that it is identical to *N. tenuissima*.

This species is particularly graceful in its long continuous central axis upon which are borne small, tight whorls of leaves at regular intervals, giving somewhat the appearance of a series of balls distributed along the stem. Its regular straight habit of growth separates it from *N. gracilis*, even in the field. The uniformly 2-celled terminal rays beyond the last leaf division, strongly reticulate oospore membrane, and the absence of sex organs at the first leaf division further distinguish it from *N. gracilis*.

Illustrations: Allen, 1896, unnumbered plate; Groves and Bullock-Webster, 1920, pl. 14; Migula, 1897, p. 176, and 1925, p. 217.

Localities: East Harbor—*A. J. Pieters a-27*, 1898 (NY) as *N. tenuissima*; and *A. J. Pieters a-27½*, 1898 (NY) as *N. batrachosperma*, redet. *N. tenuissima*, *fide* Nordstedt.

4. **Nitella megacarpa**[10] Allen, Char. Amer. Exsicc. No. 3, 1880.

Nitella microcarpa subsp. (*N. megacarpa* Allen), Nordstedt *in* Braun, Abh. k. Akad. Wiss. Berlin, 1882, p. 73, 1883.

Nitella intricata Halsted, Proc. Boston Nat. Hist. Soc. 20: 178, 1879, according to Nordstedt *in* Braun, Abh. K. Akad. Wiss. Berlin, 1882, p. 73, 1883.

Nitella polyglochin Braun *sensu latiore*, subsp. *megacarpa*, Allen, *loc. cit.*

Plate I, Fig. 4

Plant monoecious, varying up to about 40 cm. high. Leaves about 6 in a whorl, 4-times divided; ultimate rays (dactyls) in two parts, including the small mucronate tip and the lower, large penultimate cell. The mucronate tips varying from single-celled mucros, to mucros with a penultimate cell, to a 2–4–cuspidate crown (Plate I, fig. 4-A). Oogonia and antheridia occurring at the nodes of the leaves, frequently isolated. Oospores 400–530 μ long, showing about 7 broad, low striations. Oospore membrane of irregularly distributed rounded tubercles, varying into a reticulate pattern, and in many cases coalescing into a continuously beaded or smooth reticulation. Antheridia about 400 μ in diameter.

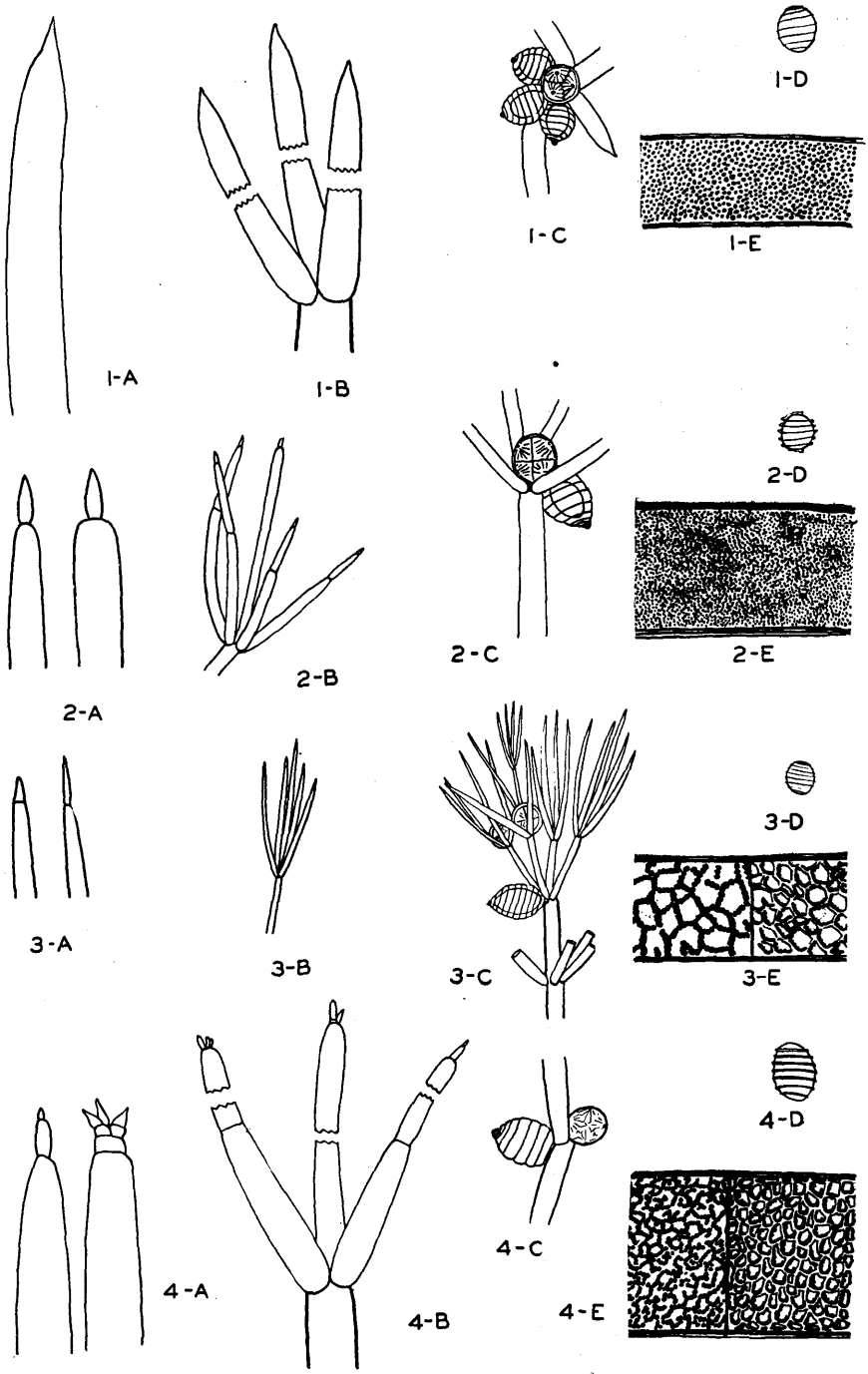
This plant was reported by Pieters (1901) as *N. polyglochin*, but the specimen is identical to Allen's type of *N. megacarpa*.

[10]Just what Allen intended to mean by his description: "*N. megacarpa Nov. sp.*—subsp. *N. polyglochin* Braun *sensu latiore*," is not clear. This is particularly awkward as Allen (1888, p. 47) made a subgeneric section "brachy-dactylae" as equivalent to "*N. polyglochin* A. Br. in its broadest sense." Based upon this fact, and upon the definite "*Nov. sp.*," the writer has retained *N. megacarpa* in this paper.

Zaneveld (1940, p. 103) includes *N. polyglochin* Braun, *in sensu latiore*, under *N. microcarpa* var. *microglochin* (Braun) Zanev. in a new combination. If this is substantiated, Allen's *N. megacarpa* will be reduced to a form of var. *microglochin*, or included as a synonym.

EXPLANATION OF PLATE I

FIGS. 1–4. In each case *A*. refers to terminal cell of leaf, × 40; *B*. dactyls, × 20; *C*. fruiting leaf, × 20; *D*. oospore, × 20; *E*. a portion of the oospore membrane between two striations, × 220 (in figs. 3-E and 4-E, two phases of pattern shown). Fig. 1. *Nitella subglomerata* Braun (1-A through 1-D after Allen, 1-E after Woods). Fig. 2. *N. gracilis* (Sm.) Ag. (after Groves and Bullock-Webster). Fig. 3. *N. tenuissima* (Desv.) Kütz. (3-A, 3-B, 3-E after Groves and Bullock-Webster; 3-C, 3-D after Migula). Fig. 4. *N. megacarpa* Allen (camera lucida drawings from No. 3, Characeae Americanae Exsiccatae, author's herb.).


1-A
1-B
1-C
1-D
1-E
2-A
2-B
2-C
2-D
2-E
3-A
3-B
3-C
3-D
3-E
4-A
4-B
4-C
4-D
4-E

In the field, the broad clumps of leaves give somewhat the appearance of a *Myriophyllum* or *Utricularia*.

Illustrations: None.

Exsiccatae: Allen, Char. Amer. Exsicc. No. 3, 1880.

Localities: East Harbor—*A. J. Pieters a-26*, 1898 (NY), as *N. polyglochin*.

Genus **Tolypella**

Branches usually more than two to a stem node. Sterile leaves simple or divided; fertile leaves furcate with very unequal rays, normally forming dense heads. Antheridia and oogonia usually long-stalked. Antheridia solitary, lateral at the nodes of the leaves or at base of leaf whorls. Oogonia always aggregated. Oospores subglobose.

5. **Tolypella intertexta** Allen, Bull. Torrey Bot. Club, 10: 115, pl. 42, 1883.

Plate II, Fig. 1

Plant monoecious, varying up to 50 cm. high. Sterile leaves 8 in a whorl, divided toward the apex into 3 or 4 rays. Fertile leaves densely contracted into heads situated in the vortex of the whorls of sterile leaves, 2- (rarely 3-) times divided. Oogonia aggregated at the fertile leaf nodes. Oospore 450–475 μ long, showing 10 acute striations. Antheridia short-stalked, about 380 μ in diameter, borne laterally at the fertile leaf nodes.

This species is readily distinguished from the Nitellas by the large, dense heads of fertile leaves amid the whorls of long sterile leaves. *N. subglomerata* has somewhat this appearance (cfr. *N. subglomerata*), but this character is not apparent in the field in contrast to the striking "birds-nest" appearance of *T. intertexta*.

Pieters (1901) reported this plant for the region: "Occurs in Hatchery Bay, but the plants are nowhere thrifty." In 1941, the writer dredged the entire shore of Put-in-Bay, which includes Hatchery Bay, in an unsuccessful attempt to recover this species. Pieters stated further: "In some spots an abundance of *Chara contraria* was found with a trace of *C. coronata* and *Tolypella intertexta*, but there are but few Characeae in Put-in-Bay. In the deeper parts of Lake St. Clair, *Tolypella intertexta* covers the bottom with a luxuriant growth, but in Put-in-Bay this species is scarce and the plants are small."

Illustrations: Allen, 1883, pl. 42; 1888, p. 50.

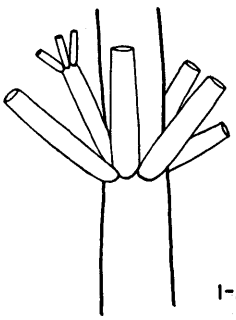
Localities: Hatchery Bay—*A. J. Pieters a-1*, 1898 (NY); in Put-in-Bay, west arm near U. S. F. Commission Hatchery. In about 10–15 feet of water—*A. J. Pieters a-1*, 1898 (NY). Note: Both specimens apparently from same collection, but occur on different sheets with different collection data, but with same number, *a-1*.

Tribe **Chareae**

Plants with or without lime incrustation. Stem and leaves with or without cortical cells. Branches similar to the main stems, usually one at a stem node in the axil of the oldest leaf. Leaves 6–16 in a whorl at each stem node, not furcate, with one-celled leaflets at the leaf nodes (reduced to mere cells in certain species). Stipulodes at the base of the leaves in a double or single row, or rudimentary. Cells of the coronula in a single row of five cells.

EXPLANATION OF PLATE II

FIGS. 1–3. In each case *A.* refers to stem node, showing stipulodes in figs. 2-3, × 20; *B.* fruiting leaf nodes, × 20; *C.* terminal cells of leaf, × 20; *D.* leaflets at sterile leaf node, × 20. Fig. 1. *Tolypella intertexta* Allen (1-A, camera lucida drawing from *Pieters a-1* (NY), 1-B through 1-D after Allen). Fig. 2. *Chara Braunii* Gmelin (1-A through 1-C after Groves and Bullock-Webster; 1-D camera lucida drawing from *R. D. Wood 106* (F)). Fig. 3. *C. Schweinitzii* Braun (1-A, 1-C after Woods; 1-B after Allen; 1-C camera lucida drawing from *J. Gray 1* (RDW)).



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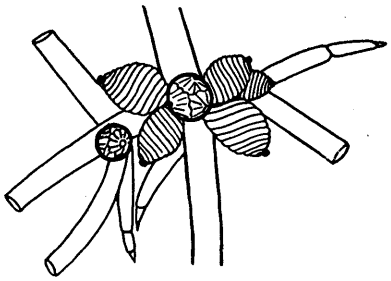
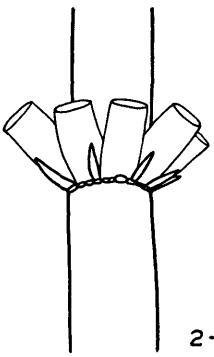


1-B

1-C



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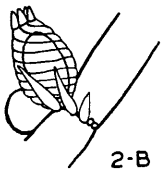
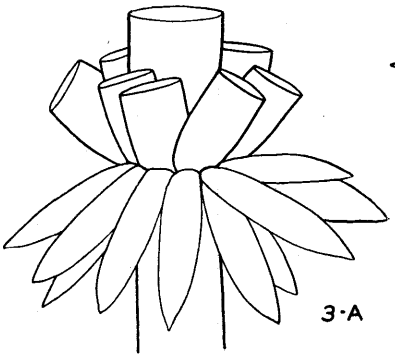


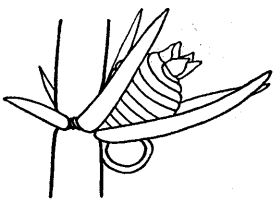
2-B

2-C

2-D



3-A



3-

3-C

3-D

Genus **Chara**

Stems and leaves corticated or uncorticated. Stipulodes always present, sometimes rudimentary. Leaves consisting of 5–14 articulations. Leaflets 5–7, the posterior (abaxial) ones frequently reduced. In monoecious species, antheridia and oogonia either borne at different leaf nodes, or the antheridia at the base of the oogonia.

6. **Chara Braunii**[11] Gmelin, Fl. Bad. 4: 646, 1826.

Robinson, Bull. N. Y. Bot. Gard. 4: 258, 1906.

Chara coronata Ziz. (*ined.*, *c. annum* 1814) Braun, Ann. Sci. Nat., ser. II, 1: 353, 1834.

Allen, Amer. Nat. 16: 358, 1882. Daily, Butler Univ. Bot. Studies, 6: 155, 1944; *ibid.* 7: 129, 1945.

Plate II, Fig. 2

Plant monoecious, varying up to 20 cm. high. Stems and leaves sometimes partly incrusted with lime, totally uncorticated. Leaves 10–12 in a whorl. Stipulodes at the base of the leaves in one series, alternating with the leaves, and generally spreading. Bract cells at the base of the oogonia shorter than the mature oogonia. Leaflets of the sterile leaf nodes rudimentary. Oogonia and antheridia borne together at leaf nodes, antheridia at base of oogonia. Oospore 520–600 μ long, showing 7–9 striations. Antheridia 250–275 μ in diameter.

Allen (1882b) made a detailed study of the American forms of *C. coronata* (= *C. Braunii* Gm.), and concluded that the species was so polymorphic with intergradations that to attempt to describe specific forms was impractical. In collections of plants from the Put-in-Bay region this conclusion is well demonstrated, as forms intergrading between this species and *C. Schweinitzii* occur regularly. Zaneveld (1940), however, reviewed the species critically, and concluded that *C. Braunii* could be separated into six distinct varieties. The *C. Braunii* of the Put-in-Bay region would agree with *C. Braunii* var. *Braunii*, and our *C. Schweinitzii* with *C. Braunii* var. *Schweinitzii*. In both cases, the writer was able only to assign the various local intergrades either to one or the other species as approaching *C. Braunii* or *Schweinitzii*. Certainly, the recent monographic works which unite these forms into one species have taken the step in the right direction.

The fact that this species is absolutely uncorticated throughout frequently results in its being mistaken for a *Nitella*. However, the presence of stipulodes at the base of the leaves immediately separates it from *Nitella* and *Tolypella*. *C. Braunii* differs from *C. Schweinitzii* in having the leaflets at the sterile leaf nodes rudimentary instead of forming a ring of spines, and by the bracts at the base of the oogonia shorter in length than the mature oogonia.

Illustrations: Groves and Bullock-Webster, 1924, pl. 26; Woods, 1894, pl. XXX, fig. 1, 4, labeled *C. coronata;* Migula, 1925, p. 226, and 1897, p. 324, both labeled *C. coronata.*

Localities: Put-in-Bay—*A. J. Pieters a-23*, 1898 (NY) as *C. coronata, microptila, incrustata;* East Harbor—*A. J. Pieters a-41*, 1898 (NY) as *C. coronata;* Carp Pond, East Harbor—*A. J. Pieters a-42*, Aug. 10, 1898 (NY) as *C. coronata;* Just S. W. of Gibralter Laboratory dock along Alligator Bar, 3–5 foot littoral over grave[1]—*R. D. Wood 106*, Aug. 27, 1941 (F).

7. **Chara Schweinitzii**[12] Braun, Ann. Sci. Nat., ser. II, 1: 353, 1834.

Robinson, Bull. N. Y. Bot. Gard. 4: 249, 1906.

Chara coronata Schweinitzii Braun, Flora 18: 60, 1835.

Chara coronata Ziz. Braun, in part. Daily, Butler Univ. Bot. Studies, 4: 156, 1944.

Chara coronata forma *macrocarpa, meioptila, verticillata, tenuior, leiopyrena* Allen, Amer. Nat. 16: 364, 1882.

Chara coronata forma *macrocarpa, macroptila, verticillata, laxior, leiopyrena* Allen, *ibid.* p. 365.

Chara coronata forma *meiocarpa, microptila, unilateralia, laxior* Allen, *ibid.* p. 366.

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[11]Zaneveld's (1940, p. 141) classification includes our specimen in his combination *Chara Braunii* var. *Braunii* (Braun) Zanev. forma *typica* Zanev. The frequent use of *C. coronata* Braun (1834) must be considered a later homonym of *C. coronata* Bischoff (1828), and both later homonyms of *C. Braunii* Gmelin (1826).

[12]Zaneveld (1940, p. 139) cites this species as *C. Braunii* var. *Schweinitzii* (Braun) Zanev.

Plate II, Fig. 3

Plant monoecious, varying up to 150 cm. high (in our region usually less than 30 cm. high). Stems and leaves sometimes partly incrusted with lime. Leaves 8–11 in a whorl. Leaflets at sterile leaf nodes forming a ring of small spines about each node. Stipulodes at the base of the leaves alternating with the leaves, in one row, and generally spreading. Bract cells at the base of the oogonia 1½–3 times as long as the mature oogonia. Antheridia at the base of the oogonia at the leaf nodes. Oospores 520–650 μ long, showing 9–11 striations. Antheridia 280–320 μ in diameter.

In our region specimens frequently show in the field a banded mottled effect due to incrustation of lime across the leaf node. This is very obvious even when seen from a boat. Many plants form a bushy rather than attenuated growth in quiet, shallow water. It can generally be separated from *C. Braunii* by the ring of leaflets at the sterile leaf nodes, and the bract cells which are 1½–3 times as long as the mature oogonia (cfr. *C. Braunii*).

Illustrations: Allen, 1882b, p. 364, fig. 5, and p. 366, fig. 7; Woods, 1894, pl. 30, fig. 2, 5, 6, and 7, labeled *C. coronata*.

Localities: Fisher's Pond—*J. Gray 1*, Aug. 7, 1940 (RDW), *3*, *4* (F); Fisher's Pond—*G. Marguard 5*, Aug., 1940 (RDW); in first embayment west of Erie Isle Dock, South Bass, protected 2 feet of water—*R. D. Wood 109*, Aug. 27, 1941 (F) as *C. contraria*, but includes mostly *C. Schweinitzii;* Shallow water in embayment east of Oak Point in Squaw Harbor, Put-in-Bay—*R. D. Wood 110*, Aug. 27, 1941 (F) as *C. contraria*, but includes mostly *C. Schweinitzii;* East Harbor—*A. J. Pieters a-32*, 1898 (NY) as *C. coronata, meiocarpa, meioptila;* Squaw Harbor—*A. J. Pieters a-74* (NY) as *C. coronata* f. *incrustata.*

8. **Chara contraria** Braun *ex* Kützing,[13] [14] Phyc. Germ. p. 258, 1845.

Halsted, Proc. Boston Nat. Hist. Soc. 20: 187, 1879. Robinson, Bull. N. Y. Bot. Gard. 4: 265, 1906. Woods, Fl. Nebraska, p. 126, 1894. Daily, Butler Univ. Bot. Studies, 6: 158, 1944; *ibid.* 7: 127, 1945.

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[13]The author citation "Braun *ex* Kützing" apparently has not appeared in the literature. In Kützing's description, the name appears as "*C. contraria* Braun." Our usage thus indicates that Braun did not validly describe the species; but in describing it, Kützing ascribed the new species to Braun (cfr. International Rules, Art. 48 (1935)).

[14]Since the completion of the manuscript, the collections of R. B. Gordon have brought to the attention of the writer certain specimens which show features generally attributed to *C. vulgaris* L. As the intergradations between these aulocanthous forms and typical tylacanthous *C. contraria* seem to make a clear-cut differentiation impossible, the author has decided to include these aberrants in *C. contraria* to which the vast majority of the local specimens clearly fall. An analysis of *C. vulgaris* with the aberrant specimens seen is given herewith.

Chara vulgaris Linnaeus, Spec. Plant., 2: 1156, 1753, *pro parte.*

C. foetida Braun, Ann. Sci. Nat., ser. II, 1: 354, 1834.

Plant monoecious, varying up to 50 cm. or more high. Leaves 7–9 in a whorl, frequently with 2 or more uncorticated terminal cells. Stipulodes at the base of the leaves in two rows, short and blunt, generally well developed. Spine cells on internodes of stem appearing to arise from furrows between the ridges (aulocanthous, a feature especially noticeable in dried specimens), usually mere papillae. Corticating cells of stem twice the number of leaves in an adjacent leaf whorl, quite regular in pattern. The secondary cortical cells more prominent than the primaries. Antheridia at base of oogonia at same node. Oospores golden-brown to dark brown, ellipsoid or ellipsoid-cylindrical, 425–675 μ long, showing 12–15 low striations. Antheridia 325–500 μ in diameter.

This species is separated from *C. contraria* primarily by the aulocanthous cortication in which the secondaries are more prominent than the primaries. In *C. contraria*, the primaries are more prominent than the secondaries (tylacanthous); and in dried specimens the spine cells or cortical nodes appear on the ridges.

Illustrations: Groves and Bullock-Webster, 1924, pl. 28; Migula, 1897, p. 560, and 1925, p. 235.

Localities: Marl Pit, Castalia, Erie County—*R. B. Gordon* **1**, Aug. 7, 1946 (RBG); Blue Hole, Castalia, Erie County—*N. B. Green* **4**, Aug. 18, 1946 (RBG); *R. B. Gordon* **4**, Aug. 18, 1946 (RBG); Miller Blue Hole, Sandusky County—*R. B. Gordon* **6**, June 28, 1946 (RBG). (These specimens are also cited under *C. contraria* above.)

Plate III, Fig. 3

Plant monoecious, varying up to 50 cm. or more high. Leaves 6–10 in a whorl, with 2 or more uncorticated terminal cells. Stipulodes at the base of the leaves in two rows, short and blunt, occasionally greatly reduced. Spine cells on internodes of stem usually rudimentary, but occasionally short spines occur on the upper stem internodes. Corticating cells of stem twice the number of leaves in an adjacent leaf whorl (diplostichous), quite regular in pattern. Antheridia at base of oogonia at same node. Oospores black, 600–720 μ long, showing 10–13 striations. Antheridia 300–490 μ in diameter.

Specimens reported by Pieters (1901) as *C. intermedia* from Put-in-Bay do not differ in any apparent aspect from *C. contraria* (cfr. Braun, 1883, p. 153; Robinson, 1906, p. 267).

This species is very similar to *C. fragilis* in appearance, but the latter has triplostichous stem cortication, and the stipulodes at the base of the leaves are rudimentary and obscure. It is very difficult to differentiate *C. contraria* from *C. Macounii* except in good specimens. In the latter species the rootlets generally bear white, starchy bulbils on the rhixoids, the cortical cell pattern is quite irregular with secondary cells overlapping so as to give occasionally a triplostichous appearance, and the plant is dioecious (with rare exceptions with extreme protandry).

Illustrations: Groves and Bullock-Webster, 1924, pl. 23; Migula, 1897, p. 436, and 1925, p. 228.

Localities: Haunk's Pond—*R. D. Wood 13*, Aug. 7, 1940 (F), *14* (RDW); Put-in-Bay—*A. J. Pieters a-71*, July 22, 1898 (NY) as *C. intermedia* A. Br.; protected shoal on Lake Erie shore of gravel just W. of Fisher's pond, Middle Bass, 2 inches of water—*R. D. Wood 104*, Aug. 27, 1940 (F); in bayou along east shore of Put-in-Bay on South Bass, just N. E. of Perry Monument, 6 inches of water—*R. D. Wood 105*, Aug. 27, 1941 (F), is a form with nearly naked leaves; Gibralter dock to west along shore—*R. D. Wood 107*, Aug. 27, 1941 (F), a deep water attenuated form; dock at Gibralter, Put-in-Bay, 3 feet of water—*R. D. Wood 108*, Aug. 27, 1941 (F); Blue Hole of Castalia, Erie County—*J. C. Myers 15, 16, 17*, Aug. 9, 1940 (F), and *N. B. Green 4*, Aug. 18, 1946 (RBG), as *C. vulgaris* L.; Miller's Blue Hole, Sandusky County—*R. B. Gordon 6* and *7*, June 28, 1946 (RBG); Marl Pit, Castalia, Erie County—*R. B. Gordon 1*, Aug. 7, 1946 (RBG).

9. **Chara Macounii** (Allen) Robinson, Bull. N. Y. Bot. Gard. 4: 281, 1906.

Chara aspera var. *Macounii* Allen, Bull. Torrey Bot. Club, 9: 44, pl. 21, fig. B. 4–6, 1882.

Chara aspera Willdenow, Mag. Ges. naturf. Freunde Berlin, 3: 298, 1809. Daily, Butler Univ. Bot. Studies, 7: 126, 1945, as "Nearest var. *Macounii* Allen or *Chara Macounii* Allen as Robinson, 6, considered it."

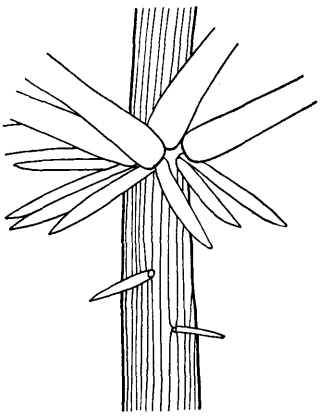
Plate III, Fig. 2

Plant dioecious, or very rarely monoecious with antheridia and oogonia on different nodes; varying up to 10 cm. high. Leaves 6–8 in a whorl, corticated throughout except for 1–3 terminal uncorticated cells. Stipulodes at the base of the leaves reduced to ovate or oblong cells, generally pointed, in two rows. Spine cells present on upper stem internodes, but usually reduced to mere papillae. Corticating cells of the stem diplostichous, though by overlapping of the secondary cells of the cortical nodes may appear triplostichous for a short distance from that node; tending to be very irregular in pattern. Oospores about 420 μ long, showing about 8–10 striations (?).[15] Antheridia about 620 μ in diameter.

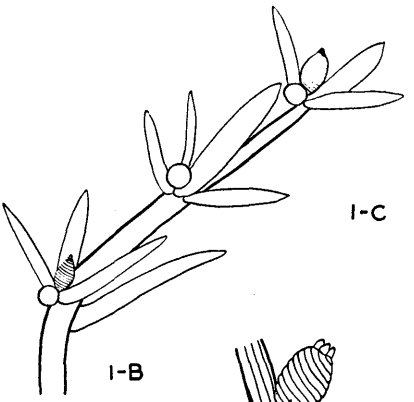
[15]The herbarium material including the type of this species seen by Robinson, Allen, and the author, has all been immature; and exact dimensions of the oospore and number of striae cannot be given with certainty.

EXPLANATION OF PLATE III

FIGS. 1–4. In each case *A.* refers to stem node showing stipulodes at bases of leaves, × 20; *B.* fruiting node of leaf, × 20; *C.* stem cortication, × 20. Fig. 1. *Chara Keukensis* (Allen) Rob. (camera lucida drawings from No. 46, Characeae Americanae Exsiccatae, author's herb.). Fig. 2. *C. Macounii* (Allen) Rob. (2-A and 2-B after Allen; 2-C modified from Allen). Fig. 3. *C. contraria* Braun *ex* Kütz. (3-A camera lucida drawing from *R. D. Wood 14* (RDW); 3-B after Migula; 3-C after Woods). Fig. 4. *C. fragilis* Desv. *ap.* Lois. (4-A and 4-B after Woods; 4-C camera lucida drawing from *R. D. Wood 103* (F)).

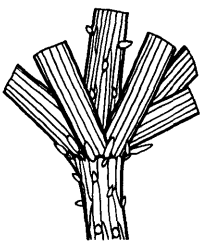


1-A

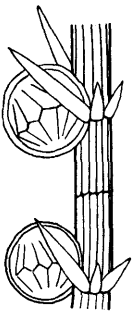


1-B

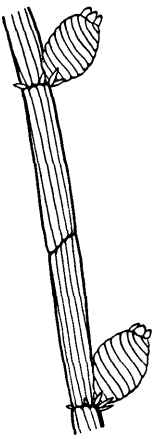
1-C



2-A

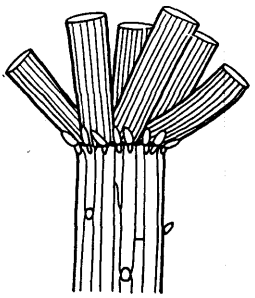


2-B

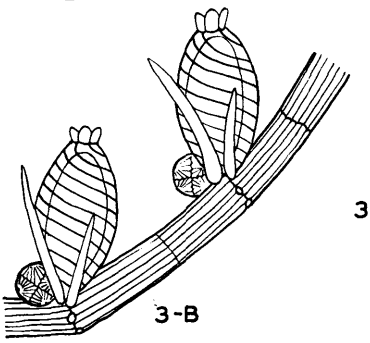


2-B

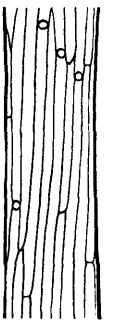
2-C



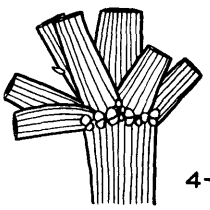
3-A



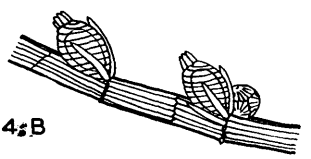
3-B



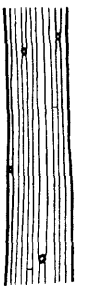
3-C



4-A



4-B



4-C

This plant was reported by Pieters (1901) as *C. aspera* Willd., but is represented in his collections at the New York Botanical Garden by a nondescript fragment. It appears to be most similar to *C. Macounii* in all ascertainable respects, but is treated here as a doubtful record.

This species is very difficult to differentiate from certain forms of *C. contraria* (cfr. *C. contraria*) except with excellent material. Certain varieties of *C. fragilis* are very similar, but I have no records of these varieties in the region. All three species form compact tufted bunches in shallow water and assume much the same appearance in this habitat. Similarly, in deep water all three species form attenuated plants. A careful study of the cortication, rhizoids, and sex organs will frequently be essential for final determination (cfr. *C. fragilis*).

Illustrations: Allen, 1882a, pl. 21.

Localities: Squaw Harbor—*A. J. Pieters 67*, 1898 (NY) as *C. aspera* Willd.

10. **Chara fragilis**[16] Desvaux *apud* Loiseleur-Deslongchamps, Not. sur les pl. à aj. à la Fl. France, p. 137, 1810.

Allen, Bull. Torrey Bot. Club, 9: 37, pl. XXII, 1882. Halsted, Proc. Boston Nat. Hist. Soc. 20: 188, 1879. Woods, Fl. Nebraska, p. 127, 1894. Robinson, Bull. N. Y. Bot. Gard. 4: 279, 1906. Daily, Butler Univ. Bot. Studies, 6: 164, 1944; *ibid.* 7: 129, 1945.

Plate III, Fig. 4

Plant monoecious, varying up to 75 cm. high. Leaves 6–9 in a whorl; corticated throughout except for the terminal 1–3 cells. Stipulodes at the base of the leaves rudimentary. Spine cells lacking on stem internodes. Corticating cells of the stem three times the number of leaves in an adjacent leaf whorl (triplostichous), very regular. Antheridia occurring at base of oogonia at same leaf node. Bract cells of oogonia generally exceeding oogonia in length. Oospores black, 550–720 μ long, showing 10–14 striations. Antheridia about 500 μ in diameter.

This species is characteristic in its smooth appearance with very regularly triply corticated stems and leaves, with no spines on the stem, and the stipulodes obscure (cfr. *C. contraria* and *C. Macounii*).

Illustrations: Allen, 1882a, pl. 21; Woods, 1894, pl. 35; Groves and Bullock-Webster, 1924, pl. 63; Migula, 1897, p. 724, and 1925, p. 242.

Localities: East Harbor—*A. J. Pieters a-33*, 1898 (NY) as f. *brevifolia;* Put-in-Bay—*A. J. Pieters a-36*, 1898 (NY) as f. *subinermis;* Haunk's Pond, Middle Bass—*R. B. Gordon 5*, Aug. 17, 1946 (RBG); Wehrle Pond, on false bottom—*R. D. Wood 103*, Aug. 27, 1941 (F); protected shoal on Lake Erie shore of gravel just W. of Fisher's pond, Middle Bass, 2 inches of water—*R. D. Wood 104*, Aug. 27, 1941 (F) as *C. contraria*, but includes fragments of *C. fragilis*.

11. **Chara Keukensis** (Allen) Robinson, Bull. N. Y. Bot. Gard. 4: 273, 1906.

Chara gymnopitys var. *Keukensis* Allen, Bull. Torrey Bot. Club, 20: 120, 1893.

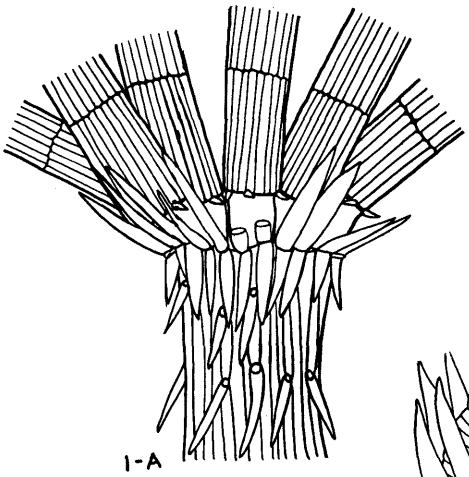
Plate III, Fig. 1

Plant monoecious, 3.5–8 cm. high. Leaves totally uncorticated, mostly 8 in a whorl. Stipulodes at base of leaves in one row, well developed and spreading. Spine cells on stem internodes few. Corticating cells of stem fundamentally twice the number of leaves in an adjacent leaf whorl (diplostichous), because the secondary cortical cells develop well in one direction. These cortical cells may develop for only a short distance in the other direction, giving an incompletely triplostichous condition. Leaflets at sterile leaf nodes developed into large cells equal in

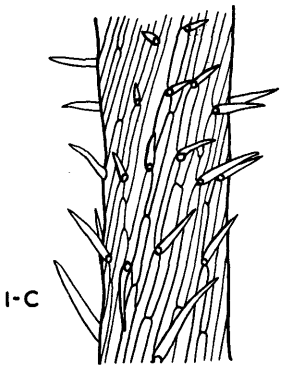
[16]According to G. O. Allen (1940) and Zaneveld (1940) *Chara globularis* Thuillier, Fl. des Env. Paris, ed. 2, p. 472, 1799, is an earlier synonym of this plant.

EXPLANATION OF PLATE IV

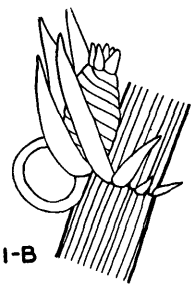
FIGS. 1–2. In each case *A*. refers to stem node, × 20 (in fig. 1-A two stipulodes removed to show uncorticated basal leaf internode); *B*. fruiting node of leaf, × 20; *C*. stem cortication, × 20; *D*. terminal cells of leaf, × 20; *E*. leaflets at sterile leaf node, × 20. Fig. 1. *Chara Haitensis* Turp. (camera lucida drawings from *W. MacLain 21* (RDW)). Fig. 2. *C. compacta* Rob. (camera lucida drawings from *R. D. Wood 41* (RDW)).



1-A



1-C



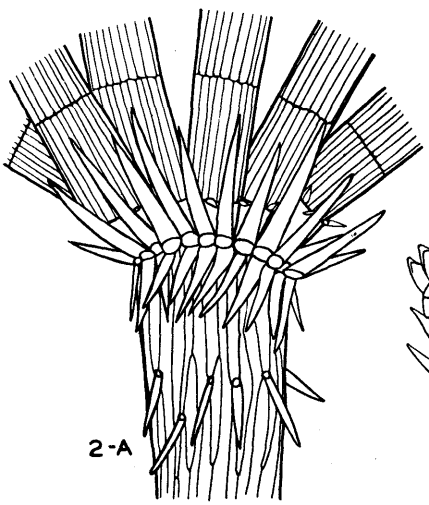
1-B

1-D

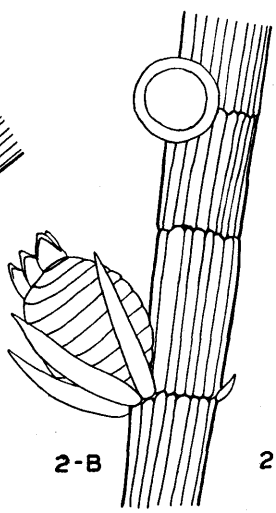
1-E

2-D

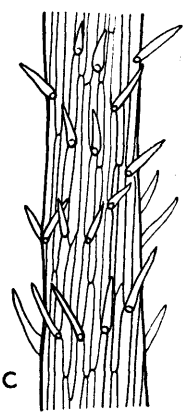
2-E



2-A



2-B



2-C

size to the leaf internodes. Bracts at base of oogonia much longer than oogonia. Antheridia and oogonia generally together at the same leaf node. Oospores 440–490 μ long, showing 9 somewhat faint striations. Antheridia 250–280 μ in diameter.

This species is distinct from all other local Characeae by regularly having uncorticated leaves but completely corticated stems. Certain forms of *C. contraria* with only one or two corticated leaf nodes might possibly be confused with it unless careful inspection is made of the whole leaves and cortications.

The plant was reported by Pieters (1901) as *C. Hydropitys* forma *compacta*. The specimen at the New York Botanical Garden is quite good, and adequate to make the present determination, which concurs with Robinson's written annotation.

Illustrations: None.

Exsiccatae: Allen, Char. Amer. Exsicc. No. 46, 1893; Robinson, *in* Collins, Holden & Setchell, Phyc. Boreali-Amer., Fasc. XXX, No. 1491, 1911.

Localities: Squaw Harbor—*A. J. Pieters 65*, 1898 (NY) as *C. Hydropitys* f. *compacta*, redet. *C. Keukensis* by Robinson.

12. **Chara Haitensis**[17] Turpin, *in* Dict. Sci. Nat. Veg. Acot., vol. 8, pl. at p. 164, 1817.
Robinson, Bull. N. Y. Bot. Gard. 4: 291, 1906.
Chara gymnopus Michauxii Braun, Amer. Jour. Sci. 46: 93, 1844 (*nomen*); Monatsb. K. Akad. Wiss. Berlin, 1858, p. 362, 1858.
Chara gymnopus var. *Michauxii* Braun *in* Allen, Char. of Amer. I, p. 2, 1880.

Plate IV, Fig. 1

Plant monoecious, varying up to 40 cm. high. Leaves 12–16 in a whorl, 3–4 cm. long, corticated except for the apical cell and the basal leaf internodal cell. Stipulodes at the base of leaves well developed, in two rows, the upper longer than the lower. Spine cells few except on the upper internodes. Corticating cells of the stem three times the number of leaves in an adjacent leaf whorl (triplostichous). Spine cells at sterile leaf nodes reduced. Bract cells at the base of oogonia shorter than the mature oogonia. Antheridia occurring at base of oogonia. Oospores 600–900 μ long, showing 13–16 striations. Antheridia about 560 μ in diameter.

From other Charas with corticated leaves, except *C. compacta*, this species is distinct by having the basal leaf internodes invariably uncorticated, and by having two rows of stipulodes at the base of the leaves well over 4 times as long as wide. From *C. compacta* it differs in having the antheridia and oogonia occurring together at the same leaf node, and in its generally much longer leaves which are quite straight instead of curved, giving a brush-like appearance to a leaf whorl. Further, the leaflets at the sterile leaf nodes are nearly obscure in *C. Haitensis;* whereas they form a ring of spines in *C. compacta.*

Illustrations: Turpin, *loc. cit.*

Exsiccatae: Allen, Char. Amer. Exsicc. No. 9, 1880; Robinson *in* Collins, Holden & Setchell, Phyc. Boreali-Amer., Fasc. E, CIV, 1911.

Localities: East Harbor—*A. J. Pieters a-31*, 1898 (NY) as *C. sejuncta;* East Harbor—*W. MacLain 21*, July 10, 1940 (RDW); Portage River—*A. J. Pieters a-53*, 1898 (NY) as *C. gymnopus* var. *Michauxii.*

13. **Chara compacta**[18] Robinson, Bull. N. Y. Bot. Gard. 4: 297, 1906.

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[17]This name appears on an adequate illustration of the plant. No written description of the plant occurs in the text. According to the International Rules, a plate is adequate to establish priority for dates prior to 1908. In this interpretation, Robinson was justified in re-establishing this synonym.

Zaneveld (1940, p. 203) included this species in his new form *C. Zeylanica* forma *typica* Zanev., and transferred it to the earlier homonym *C. Zeylanica* Willd., Mém. Ac. Roy. Berlin, 1803, p. 86, 1805.

[18]This species is given with some reservation. The specimens vary greatly in character of sterile leaf node leaflets; but the size of stipulodes, manner of their not concealing the gymnopodous leaf internodes, number of striations of oospore, and pattern of cortications most closely approach Robinson's type material of this species. Whether this species can be maintained at all is questionable, as the bases of distinction are so relatively minor. Groves (1911, p. 40) includes it under *C. sejuncta* Braun, which the writer feels is probably a more correct disposition.

Chara sejuncta Braun, according to Allen, Bull. Torrey Bot. Club, 21: 526, 1894.

Chara sejuncta forma *compacta*, *subinermis*, *microptila*, *unilateralis*, *macrospora*, *munda* (*nomen*), Allen, Char. Amer. Exsicc. unnumbered specimen (Lake Champlain and Lake Saratoga), 1894.

Plate IV, Fig. 2

Plant monoecious, but antheridia and oogonia occurring at different nodes, frequently on the same leaf; up to 20 cm. high. Leaves 12–14 in a whorl, 1.5–2.2 cm. long; corticated throughout except for the apical cell, and the basal leaf node. Stipulodes at the base of the leaves well developed, the upper row 920–1500 μ long, usually not quite reaching the top of the swollen leaf internodes. Spine cells rather frequent on upper stem internodes. Corticating cells of the stem three times the number of leaves in an adjacent leaf whorl (triplostichous). Leaflets at sterile leaf nodes forming a ring of spines. Bract cells at base of oogonia shorter than the oogonia. Antheridia and oogonia occurring at different nodes, but frequently on the same leaf. Oospores 730–770 μ long, showing 10–12 very conspicuous striations. Antheridia 360–400 μ in diameter.

This species is rather difficult to recognize in the field as distinct from *C. contraria*, *C. fragilis*, and especially *C. Haitensis* (cfr. *C. Haitensis*). However, the effect of the naked basal leaf internodes with the stipulodes gives the living material the appearance of having a very short basal leaf internode, a feature of both *C. Haitensis* and *C. compacta*. But for positive determination of the latter two species, the plants must be inspected microscopically for the leaflet structure, cortical pattern of the stem, number of striations of oospore, and especially the placement of the sex organs.

Illustrations: None.

Exsiccatae: Allen, Char. Amer. Exsicc. *loc. cit.*

Localities: Squaw Harbor—*A. J. Pieters a-37*, Aug. 26, 1898 (NY) as *C. Michauxii;* Haunk's Pond, Middle Bass—*R. D. Wood 41*, *43*, *45*, Aug. 9, 1940 (F) as *C. sejuncta* f. *compacta; 42*, *44* (RDW); *ibid. 21*, *22* (RDW) as *C. sejuncta*.

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